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ENHANCING BUSINESS PROCESS THROUGH RECOMMENDATION SYSTEM BASED ON RANKING AND QUERY REFORMULATION

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ABSTRACT

In Business process data mining and knowledge discovery plays a vital role which is more difficult to process due to the availability and enhancing nature of data every day. There is a gap between what the user wants and what the system perceives as needed by the user. One of the ways to enrich business is to personalize the websites for each user by understanding their need, interest and behavior. The main challenge is information overloading and user dynamic nature. Even for a sample of small content availability in the domain, the mismatch is significant. Information retrieval research has shown over the years that the focus of the users is over a short and limited number of results. Getting the accuracy of the results is thus a significant need. Recommendation systems for Business have focused on the match between the user and the content through methods that focus on personal profiles, server ranking and user query processing. This is the focus of this paper where authors propose. This model uses the advances in information retrieval research and leverages the basic pedagogical models. The experimental results have shown promise and thrown up some interesting challenges for the future.

Indexing terms/Keywords

Recommendation system, Query processing, Ranking, Matching and Ontology.

I.INTRODUCTION

Business environments are becoming very popular. In general if an organization understands their customer's interest and their behavior then this process will increase profit of an organization. Similarly, increasing attention to the site more and thus increases the customer utility a personalized website in view of the customer's interests may bring customer's attention. To personalize or customize a web page for user can be obtained by gathering information of user's interest and behavior. The enhancing nature of business websites on online creates a large amount of data and these needs to manage causing information overload. Therefore efficient data mining techniques are needed to handle the information overloading and an better technique is also applied to storing, managing and retrieving of web usage data. Recommender systems have ignored the content structure and models focus on user behavior and the personal preferences on the users and finesse over the content match. The domain of information retrieval has shown us that the gap between perceived results and intended results is significant. This is due to complexity of the content. Also, the user's attention span is getting smaller and smaller. Hence the recommender systems need advanced mechanisms as a part of their repertoire for content tagging and management. The content management phases need to look beyond the document management style or the data management facets and instead focus on the content tagging for modeling. This is a significant challenge. The goal of this paper is to focus on exact retrieval of information with respect to user query using recommendation system in business domain.

II. LITERATURE SURVEY

The new web era and its hypermedia architectures have led to specific field systems as the next big thing [1]. Practically all users of web based learning systems are aware of the increasing amount of well-tailored information they may access for their particular needs. Recommender systems must be flexible and reusable to reach a high degree of application and domain independence. Designing and developing a suitable recommender system may be very much helpful in web personalization. It uses the recommendations provided by the recommender systems for providing the users with their items of interest. [2], context-aware systems [3], context management systems. To serve in different contexts based on system needs there are different approaches for recommendation systems that are used [4]. The content-based approach deals with item profiles and user profiles, and it is designed to recommend text-based items.

In commercial areas the collaborative filtering approach is widely used. Amazon uses the collaborative filtering approach to recommend products to its customers [5]. Recommendation systems depends on collaborative filtering suggests items based on the similar items to a particular user have been rated by several other consumers, and the target user and the other users share the same preferences of items or products [6]. The demographic approach recommender systems use demographic information such as the gender, name, and date of birth (age) of respective users in order to recommend items [7].

To go over the limitations and drawback of the other recommendation systems approaches the hybrid approach has been introduced [8].The hybrid approach combines two or more recommendation systems methods combined together to eradicate the limits of pure approaches. Several studies show that hybrid approaches can deliver more exact recommendations when compared to other approaches.

In research work [9], data mining techniques such as finding association rules and frequent patterns are used widely to analyze learner behavior. But, finding association rules and frequent item sets are used by retailers to discover the buying habits of the customers to do market basket analysis to develop marketing strategies. Recently, in recommendation systems association rules mining has been extended to use. For example, research work in [10]; have proposed a course recommendation system based on association rules. As can be seen in the above, the work on the match between the actual content in the courses and the user's query is limited.

Key terms to propose:

- To obtain optimal result with respect to user query based on user interest. Therefore user behavior analysis would obtain better result.
- Recommendation system to extract most useful content to user query from a huge database.
- To increases the business growth by providing better results of user query based on query reformulation and ranking approach.

III.METHODOLOGY

The overall methodology of the recommender system is described briefly. The user presents the query to the system. The system generates a set of choices based on the content match. Here the issue arises, there is always a gap between user query and server displayed output. In general system displayed the related content to user search but not exact content; in addition it does not retrieve content that related to user intention. To overcome this issue recommended system is implemented where the suggestions are provided by means of ranking approach. The goal of this approach is to increase customer utility of a business and want to provide exact result with respect to their interest.

The working of proposed system is explained briefly, initially a user history is analyzed in order to identify the interest. Therefore a set of datasets are taken and analyzed in order to identify user interest. Once user interest is identified it helps in developing a recommendation system. Second thing is user query, query should be reformulated in order to obtain better results therefore the query should be analyzed and reformed through Blooms taxonomy.

3.1 QUERY REFORMULATION:

The query reformulation stage now has an organized set of content that can be parsed and matched. The retrieval system can expand the user query based on what the content is available in the system. Hence this expansion is done through analyzing the user history. The overall goal of query expansion is to improve precision and/or recalls are described briefly in section IV.

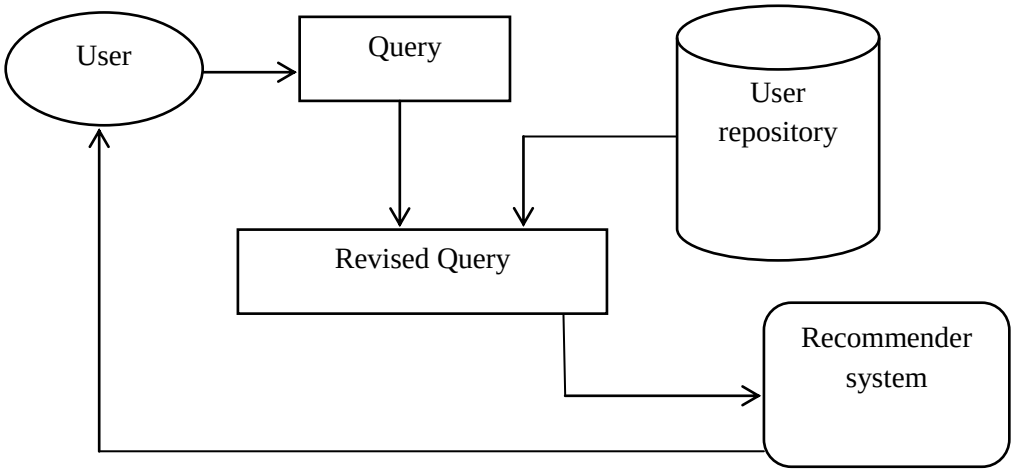

Fig 1: Recommender system for business process

Example: User Query: "Infosys"; Expanded Query: "Infosys infrastructure, Infosys reviews". Query expansion is very important as the amount of information about the courses and the modules is large. Normal search follow specific trends with their searches such as 2-3 words, broad search terms \and the fact that the users do not like to expand their queries using Boolean terms. Here the query expansion has a set of pedagogical constructs to use. There is also the match with revised bloom's taxonomy in that the words on the construct 'behavior' of above refer to the flow in the revised bloom's taxonomy as shown in Figure 2.

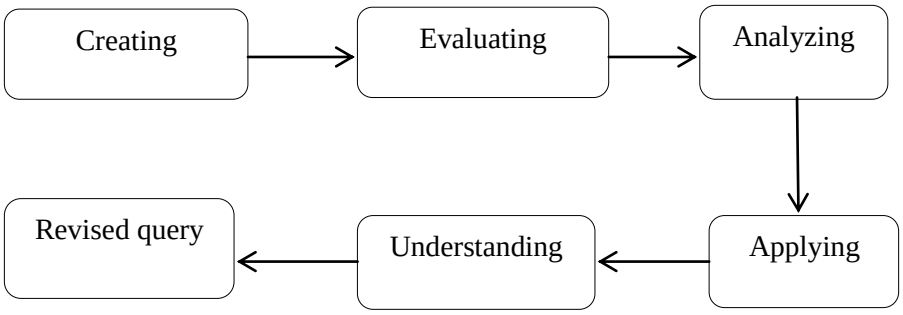

Fig 2: Revised bloom's taxonomy

The use of revised bloom's taxonomy also gives clarity to the system on whether the user queries a single learning object or combination of learning objects. For lower two levels of the revised bloom's taxonomy it is hypothesized that single learning objects might be apt suggestions. For higher levels of learning, a combination of learning objects may be needed.

- The user gives a query "Infosys"
- This question is further processed into Bloom's dimensions of learning
- All the learning objects related to the query are searched

Blooms	Query construction
Create	Design construct
Evaluate	Infosys infrastructure, Critique the Infosys
Analyze	Infosys organization, Infosys environment
Apply	Infosys organization
Understand	Infosys reviews, Infosys products
Revised query	Define Infosys, Infosys reviews Infosys infrastructure

Table 1: Query construction

For a single query there may be a lot of content fetched. To rank them, a similarity ranking algorithm based on relation between query and content terms is found. The preference order is higher for the learning outcome and objective and then the conclusion. Also, the proportional order is fixed for content that is synonymous to query and the content terms. Thus, the model will consider not just the query terms but, also the direct matches of the content in the ontology.

3.2 RECOMMENDATION SYSTEM:

Initially business process is clustered according to its types, such as manufacturing, software, hardware and others. In that again it sub clustered with respect to its title. The website read the history of user's votes on particular business and used the majority of the voting to generate recommendations. In more detail, if one user U_i likes Business B_{j1} which belongs to cluster C_{k1}, U_i will give C_{k1} one Vote on C_{k1}. On contract, if U_i dislikes Business B_{j2} in C_{k2}, U_i will cancel a Vote for C_{k2}. If a cluster gets negative Vote at the end, it will return to 0. After U_i votes all the Business process, different clusters will get different votes. The business recommendation system will recommend business according to the votes of clusters C_j as V (C_j) as follows:

$$P(C_i) = \frac{V(Ci)}{\sum_{j=1}^{n} V(Cj)} \quad \text{..... (1)}$$

Where, $P(C_i)$ = probability of business recommendation,

C_i and $V(C_j)$ are clusters,

$V(C_j)$ = number of votes in clusters,

n = number of clusters.

The accuracy of the business processing votes is calculated by the following process. If a vote is allocated to a business process then it will be considered as True Positive. Similarly False Positive is considered as number of unlike votes allocated to it.

$$\text{Accuracy} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Positive}} \quad \text{..... (2)}$$

$$\text{Accuracy} = \frac{\sum \text{Accuracy}}{\text{Total Number of Users}} \quad \text{..... (3)}$$

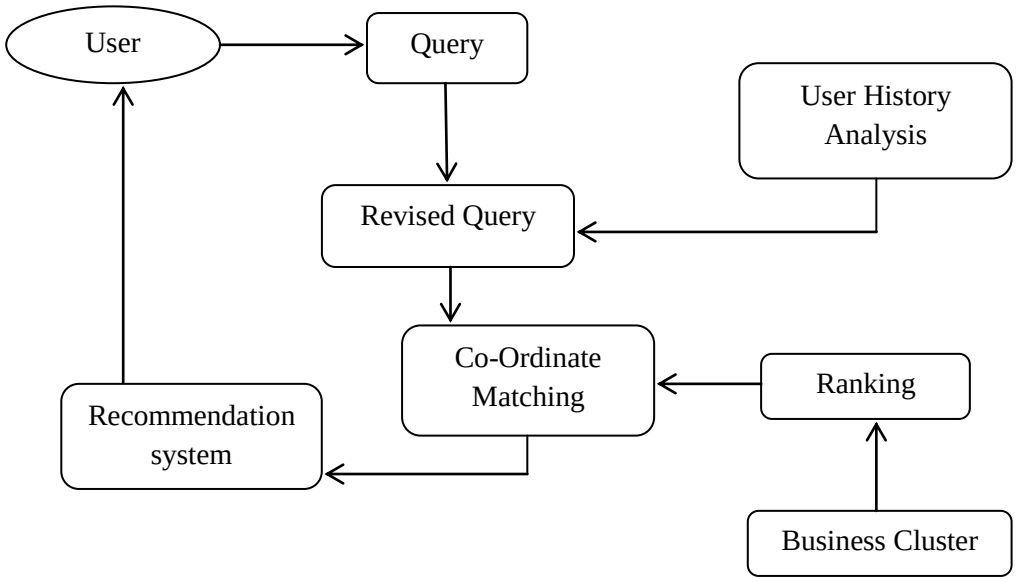

Fig 3: overall system working

The individual working process is described before and the implementation of over all working is described above. Initially, user sends a query to the server here the query reformulation is done through the user history and analysis is done and query reformulation steps are discussed early and query is formed. Another input for recommendation is ranking of all users for a particular business from database history. Here every business is clustered and collects the likes is considered to be votes and its accuracy is also calculated for effective results from recommendation system.

Once the query is entered revised query is formed based on user history analysis and ranking is created based on number of user views. Here according to query the query reformulation is done and result will be searched in the server through recommendation system the ranking of mentioned query is searched in the database. Therefore the result of query and most ranked business process is obtained as output.

The result is obtained through this process obtains better results due to its combined processing procedure which obtains better results. Where available methods analyze either user history or ranking methods therefore combining these methods in a recommendation system provides better results when compared to others..

IV. EXPERIMENT AND RESULT

The experiment and result section discusses the way of result measured and discussed. The ratio of result obtained through these experiments is also discussed in this section.

- Efficiency of the query recommendation approach in terms of precision and recall.
- Extent to which the efficiency recall of the content recommendation approach is attributable to the content based query reformulation model alone.

In Information retrieval research, the key metrics are precision and recall. The precision measures the extent to which the retrieved results are relevant. The recall focuses on the effectiveness of the retrieval process. Both precision and recall can be calculated directly as follows,

Precision = Relevant results that are retrieved / All the retrieved results ..... (4)

Recall= Relevant results retrieved / All the results that are relevant ..... (5)

These two measures give the effectiveness of the overall system. The experimental was conducted as follows. 50 users were asked to query the most relevant business process that they needed to undergo using the system. The method was blind testing using normal Boolean tags and exploration on one group (25 users) with the other group using the recommender system.

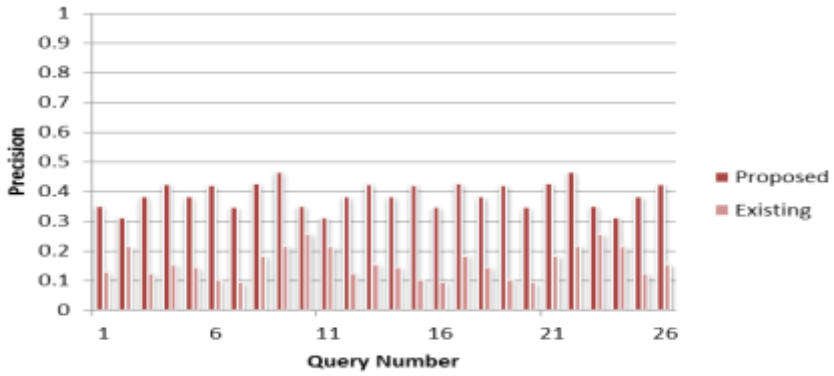

Fig 4: Precision for user query

The user interfaces were similar. Later they were requested to explore all the content and validate the results. A total of 1200 learning objects of business process were populated in the system. Each user was asked to use 2-3 queries for testing the system. The experimental results of the precision are given in Figure 4.

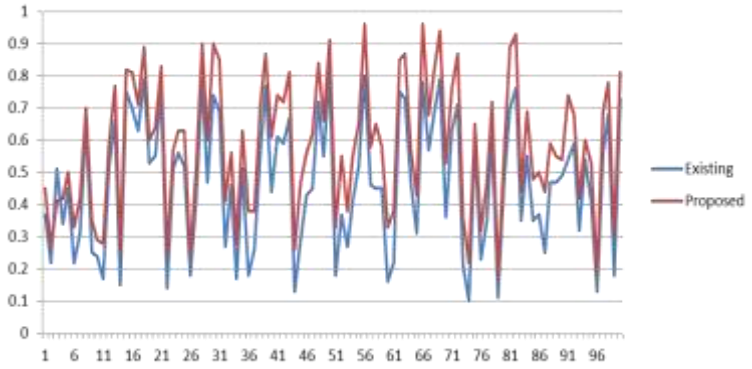

Fig 5: User access in existing and proposed systems

Query Number

As can be seen, the proposed system outperforms the existing search mechanisms by an average of 34% over 114 queries. This can be attributable to the query recommendation mechanisms. To get an idea of how relevant these results are, the recall is tabulated in Figure 5. Here too we can see that recall of the results retrieved always is higher than the threshold of 50% of the total queries whereas it fluctuates for the existing system. The key aspect here is that while precision is subjective, the recall measure is not in this case.

Model's suggestions were then compared with user behavior based recommender system that uses the keyword match algorithm. From the figure it can be seen that the overall efficiency fluctuates between -15% to +35%. In some cases, the profile match algorithm performs equal if not better top results than the content based recommender system. This is something that needs to be explored in the future.

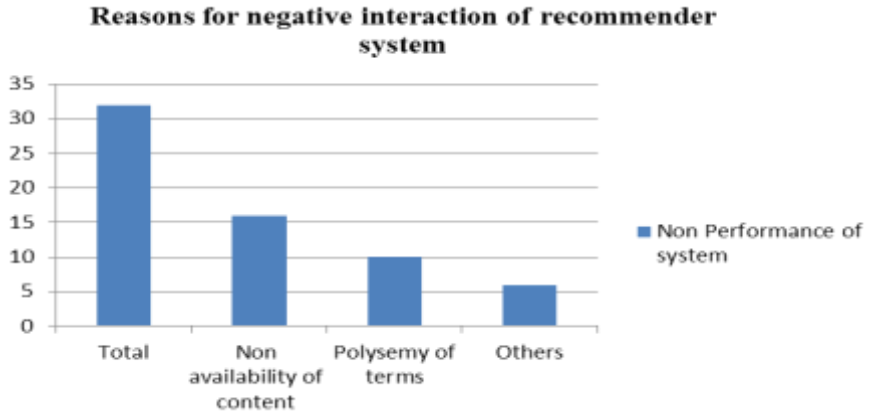

Fig 6: User interaction of the system

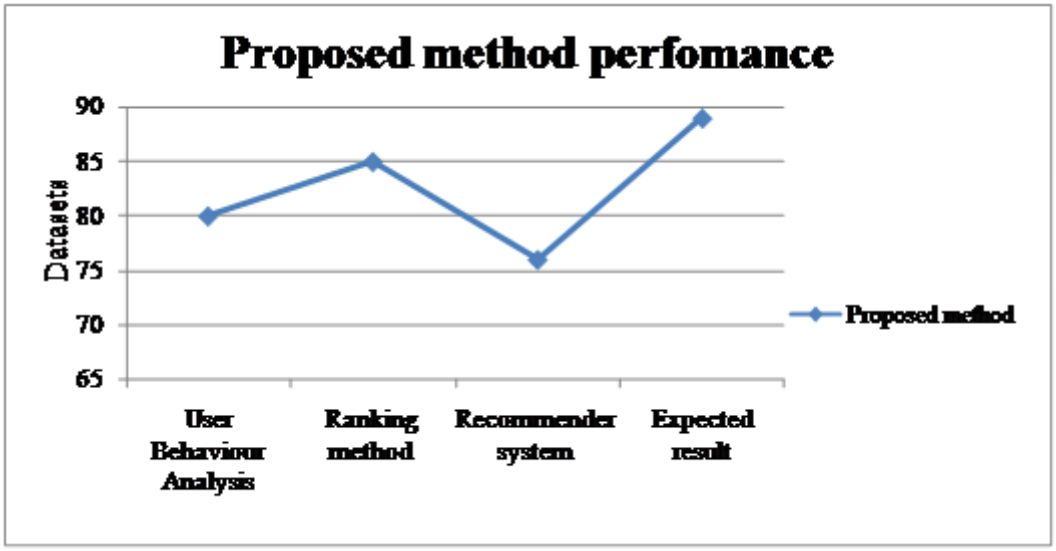

Fig 7: Proposed system performance measure

The above figure describes the percentage of proposed method with parameters such as User Behavior Analysis, Ranking Method, Recommendation System and Expected Result. Therefore the overall performance of the system is shown with respect to number of datasets in process taken for implementation.

V. CONCLUSION

Data mining involves discovering novel, interesting, and potentially useful patterns from data and applying algorithms to the extraction of hidden information. However everything become electronic way increasing business process through internet based is also increases the organization growth. Therefore providing user related query content through analyzing the user behavior from ones database. This can be more exact when recommendation is provided based on users review with respect to particular business process. As a result of this combined method produce optimal results when compared to other existing methods.

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